Space Advanced Design Program

FINAL REPORT

NAGW-4304
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Design of a
SOUNDING ROCKET PAYLOAD BUS

In the summer of 1994 the University of Cincinnati's Space Engineering Center was selected to participate in the NASA Student Launch Program. The Advanced Space Design Program (NAGW-4304) has supported the design effort for a payload bus which will be flown on a Nike-Orion Sounding Rocket in the summer of 1997. The payload bus will carry an experiment to measure atmospheric winds in the lower thermosphere and mesosphere. A comprehensive design review was held at NASA Wallops Flight Facility in December 1996 and a go ahead for fabrication of the payload was received. This phase of the project is being conducted under the NASA Space Engineering Center Program (NAGW-1407).

EXPERIMENT DESCRIPTIONS

In the atmospheric mixing experiment, chaff canisters will be deployed from the payload bus. These will have individual timers and pyros to disperse the chaff contents at 40 and 70 kilometers. Radar tracking of the chaff will indicate the rate of dispersion and mixing.

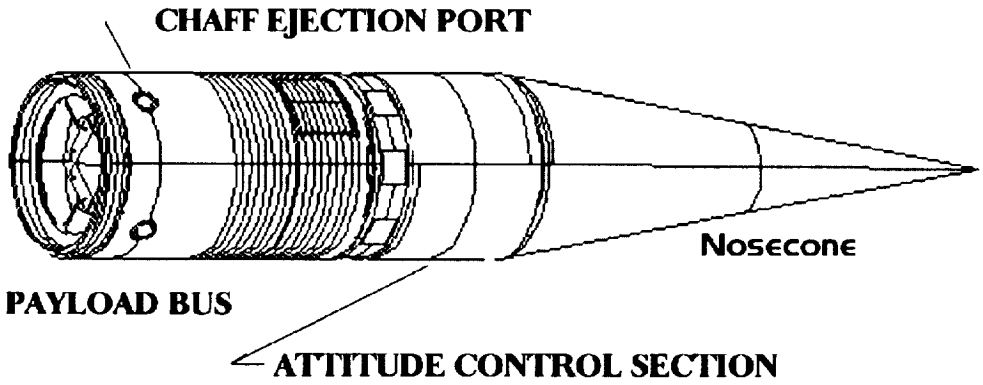
The second experiment is the Attitude Control System. It has been developed with capabilities similar to the NASA STRAP III system and similar components are used. A yo-yo despin mechanism will slow the vehicle rotation and then nitrogen gas thrusters will be fired to reorient the payload in response to preprogrammed commands.

MISSION SUCCESS CRITERIA

1) Comprehensive :
   a) Science data obtained with all systems functioning throughout flight
   b) Attitude determination to within 10 degrees
   c) Recovery of payload without contamination in critical areas
   d) Apogee altitude of 100 km

2) Minimum :
   a) Sufficient data to determine atmospheric dynamics as a function of altitude.
   b) Apogee altitude of 70 km

The payload bus was designed to be recoverable and reusable. The engineering objective was to develop a structurally efficient bus that provides necessary services for the science and engineering experiments. Shown below is the final design configuration.



Payload Weight Estimates

Section Totals	
Section	Weight (lbms)
Nosecone	18.2
ACE	42.2
Payload	87.3
Transition Despin	36.0
Recovery	45.2
Orion Ignition	24.9
Rocket Total	253.8

Three educational objectives were identified. These are for undergraduate students and other participants to 1) gain experience in all aspects of suborbital missions including planning, management, design fabrication, test, calibration, qualification and field operations; 2) improve their written and verbal communication skills; and 3) develop network and teamwork skills in the context of team diversity.

Nearly 70 undergraduate and graduate engineering students from Aerospace & Engineering Mechanics, Electrical & Computer Engineering, Materials Science, and Mechanical, Industrial & Nuclear Engineering were involved in this effort. Students were assigned to a variety of teams based upon their skills and interests. These teams were responsible for meeting the science and engineering objectives of the program. Students also had the opportunity to "crosstrain" in several areas including business development, engineering and science disciplines, and communications.

The overall program has been managed by Dr. Larry P. Cooper, Professor of Aerospace Engineering and Engineering Mechanics. He has been assisted by Professor Trevor W. Williams of Aerospace Engineering and Engineering Mechanics, and Professor Joseph H. Nevin of Electrical and Computer Engineering. A mentor group of NASA and industry participants was developed.